A Stakeholder-Based Approach to Rethinking, Reconfiguring and Recommissioning a Complex Data Center

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Topics

- The Building
- Degree of difficulty
- The “perfect storm”
- Challenge
- Approach
- Some management actions
- Some technical findings & actions
- Results
- Key factors

The Building

Building 1482, Naval Base Coronado, is a major data and telecommunications center, housing:

- West Coast hub of the Navy-Marine Corps Intranet (NMCI)
- Naval Computer and Telecommunications Station, San Diego (NCTSSD)
- Defense “Mega center”
- Dedicated cogeneration plant

Degree of Difficulty

- 10 of 10
  - Mission-critical operations
  - Highest reliability requirements
  - Tenants, including cogen plant, not subordinate to host but host command pays most of utility bill
  - Most of building historically untouched by energy managers
  - Steam & electric rates specific to this building
  - Building critical to base steam system

The “Perfect Storm”

- Following events combined to create energy “perfect storm” in FY03:
  - New NMCI load – 500 kilowatts (62% increase)
  - Higher steam & electric rates
    - Steam rate up 170%
    - Electric rate up 44%
    - Rates set during California energy crisis 2 years earlier, could not be changed
  - Steam use up 62% by March 2003
  - Electric use up 9%
- Utility bill projected to go from $3M in FY02 to $6M in FY03!

The Challenge

- Take immediate action to bring Bldg 1482 utility costs under control in FY03

Right: some of the key members of the building tune-up team

The Approach

- Formed “building tune-up” team March 2003
- Team comprised of all stakeholders, including
  - Base Public Works Team & REM
  - NMCI & NCTSSD
  - Navy Public Works Center, San Diego operators & engineers
  - Engineering consultant
- Team empowered to find, develop and execute actions to
  cut utility bill, short- and long-term, including:
  - Rate changes
  - O&M improvements
  - Facility energy improvements
- Team given ready access to all areas & functions

Some Management Actions

- Proved $250K steam metering anomaly, received credit
- PWC could not change FY03 rates in mid-year BUT
  - Was able to abolish old rates
  - Put Bldg 1482 on lower steam & electric rates for FY03
  - Established new, reasonable “chilled water”, “back-up generation” rates for FY04

Some Technical Findings & Actions

- Secured redundant absorption chiller
- Helped make cooling tower replacement project more energy efficient
- Improved data center energy efficiency
- Many others…

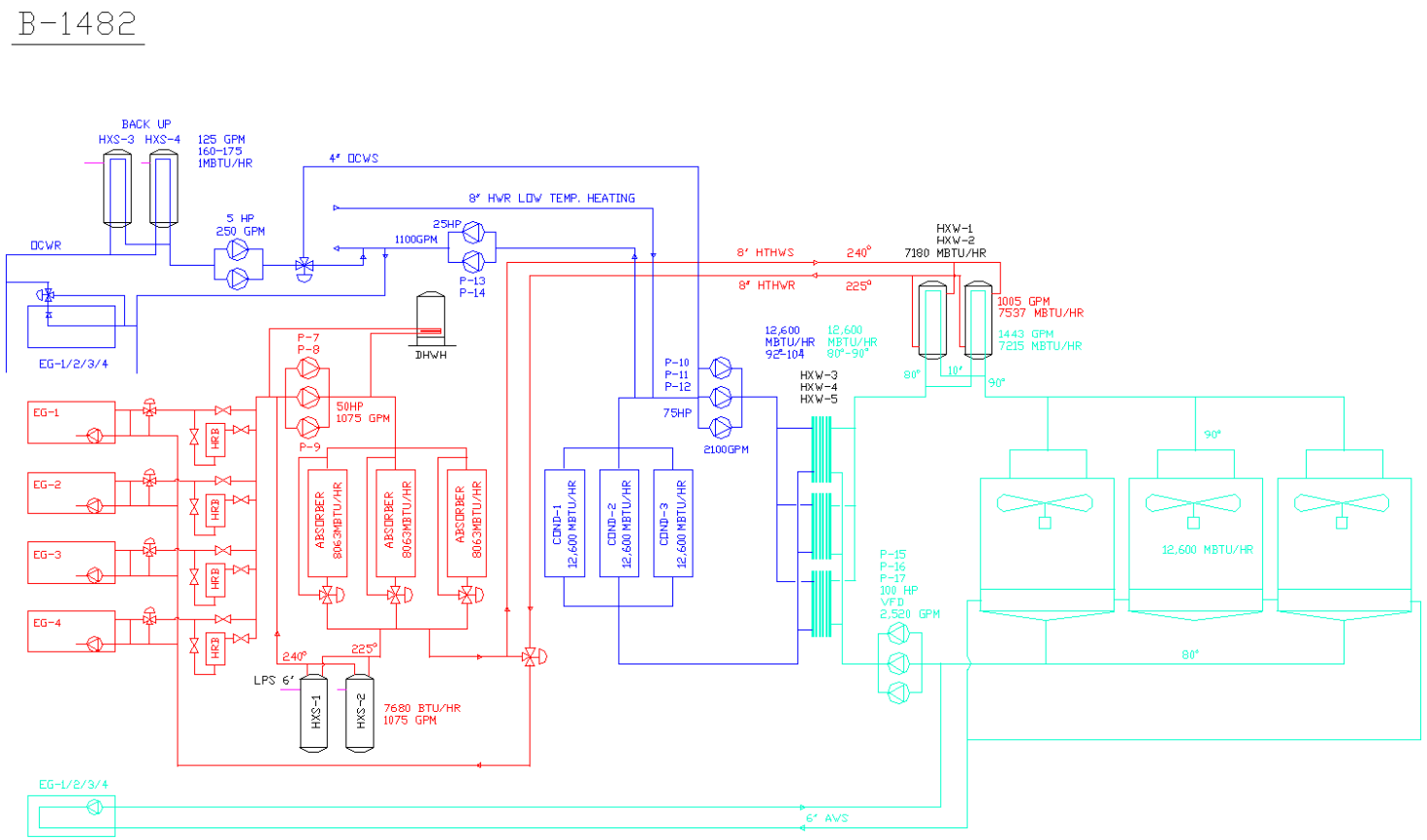
Overall Results

- $2.2 M in FY03 cost savings at internal Navy rates; *$215K in marginal savings to Government*
  - $1.25 M in savings due to rate actions
  - $950K in savings due to energy actions
- FY03 energy savings
  - 893 MWH of electricity
  - 7.3 million pounds of steam
  - 1 ¼ million gallons of water & sewage
- > $1 M additional savings expected in FY04
- ROI 6000% (or 600%)

Key Factors

- Stakeholder involvement & cooperation
- Combination of technical expertise with expert knowledge of operations
- Empowerment, command backing
- Action orientation
- Not content to continue business as usual

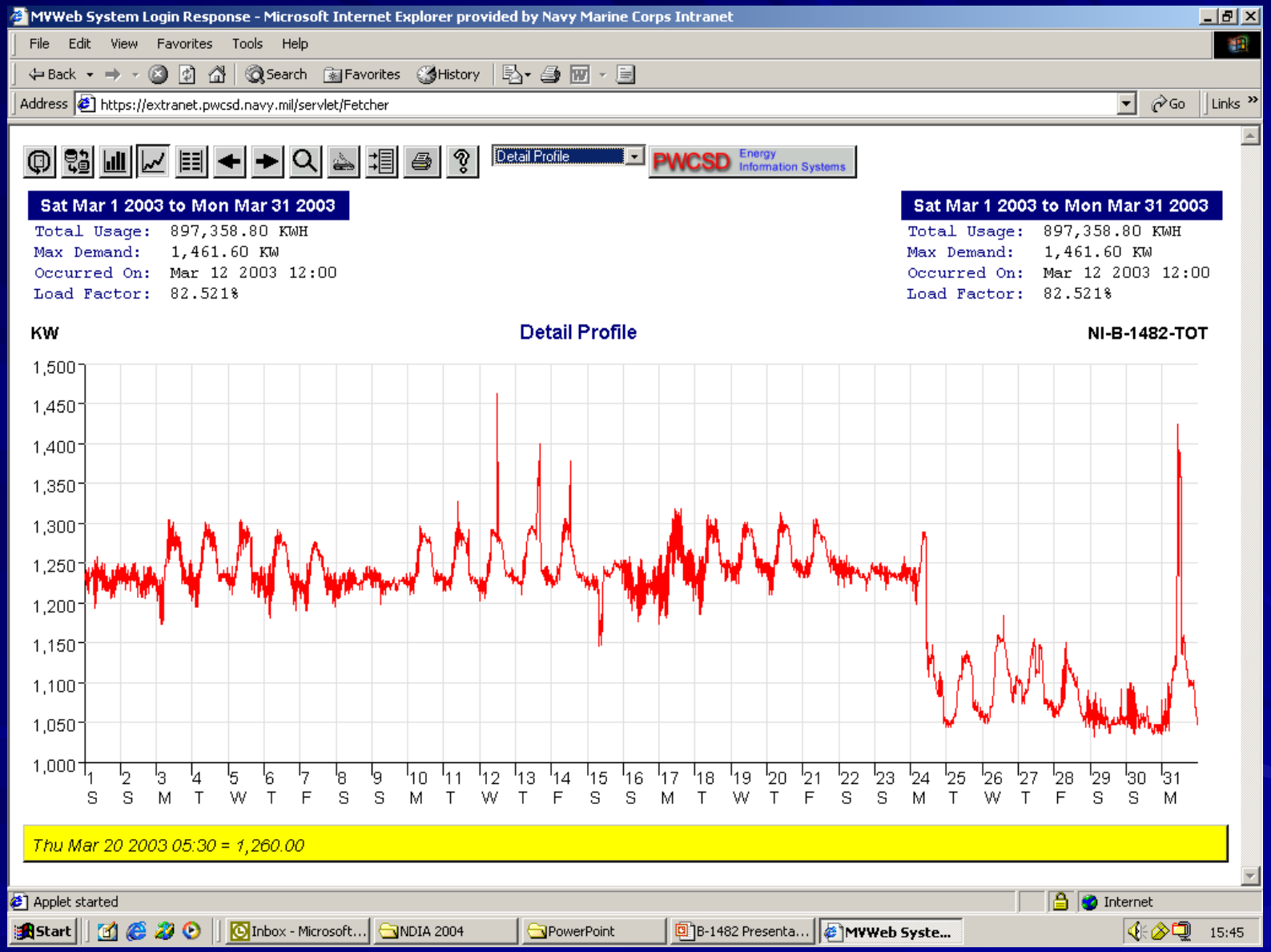
B-1482 schematic diagram



1st Action

- 2 Absorber chillers operating, both at low load

- Reason for both on: Desire to provide redundant cooling capacity to data center
- Turn one off: higher load for one chiller
- Reduce pumping power by: Give details
- Cooling tower fan power reduction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Total Usage: 897,358.80 KWH
Max Demand: 1,461.60 KW
Occurred On: Mar 12 2003 12:00
Load Factor: 82.521%
Sat Mar 1 2003 to Mon Mar 31 2003
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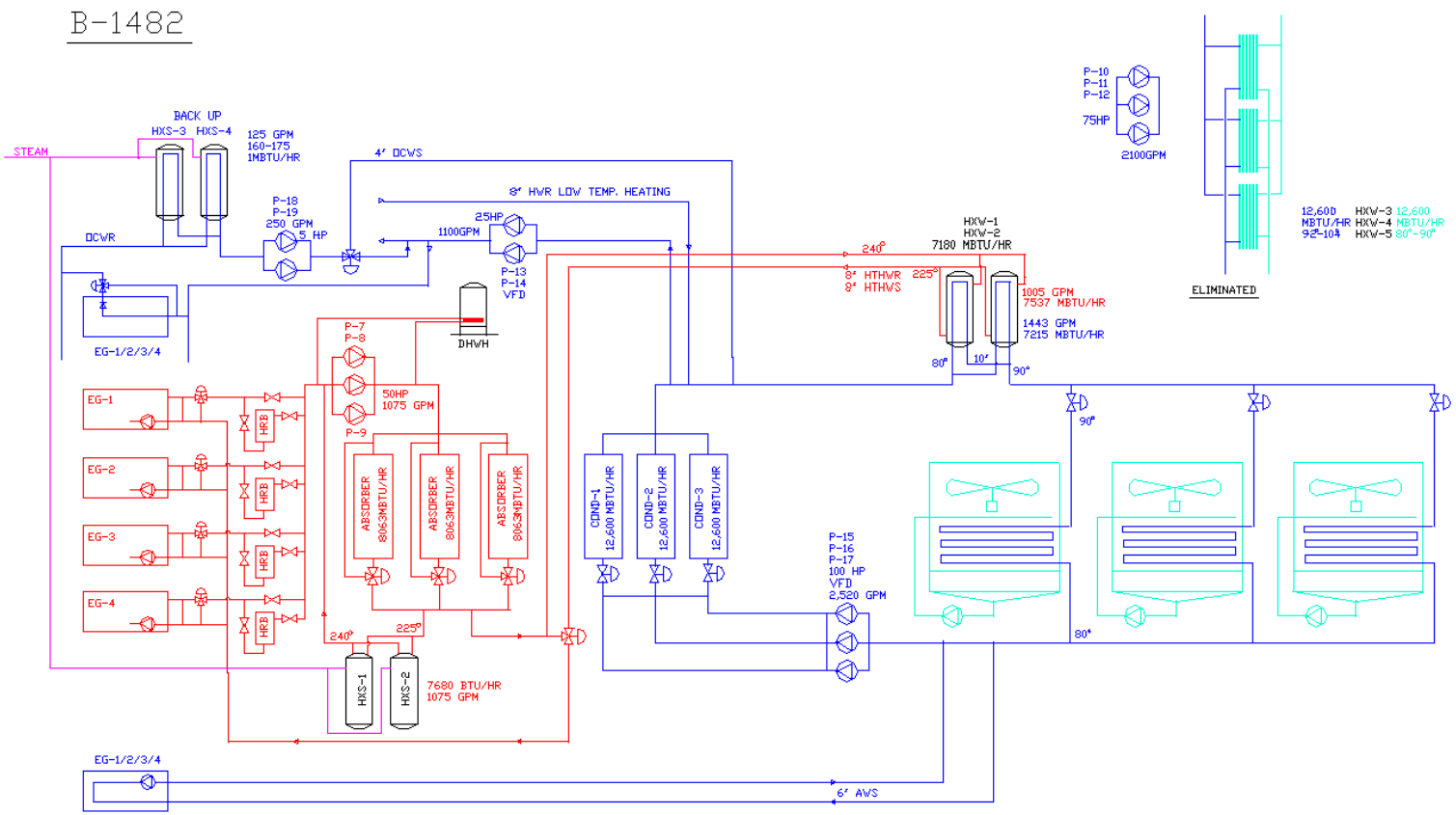
2nd Action

- Cooling Tower replacement project just awarded in March 2003 for in-kind replacement of open cooling towers
- Opportunity to get rid of heat exchangers and one set of pumps
- Advantages: Lower condensing temperatures increases chiller capacity from 400 to 600 tons
- Eliminates flat plate heat exchanger foul up

New Schematic



Server Farms - Computer Rooms

- Do computer rooms have to be like blast freezers?

No! The computers need sufficient cooling and occupants need comfort conditions

- All air handling units are running, some are
  cooling, some are heating

A little theory – low delta Temperature Syndrome

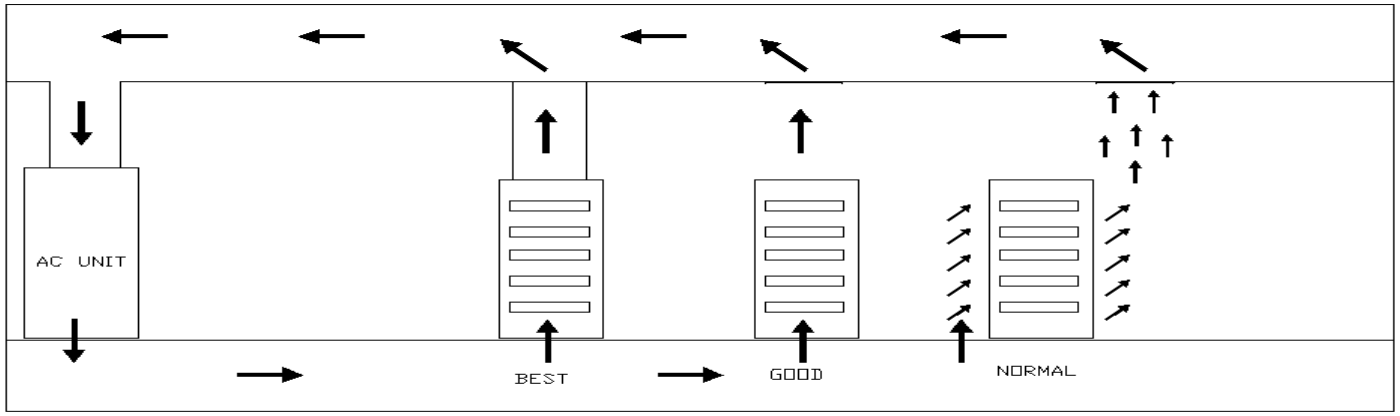
- The low delta T syndrome experienced in chilled water system applies equally to air systems.
- Heat out = k x flow rate x delta T
- Heat out = k x cfm x delta T

Cooling coils are designed for 15 to 20°F from 55 to 60°F supply air temperature

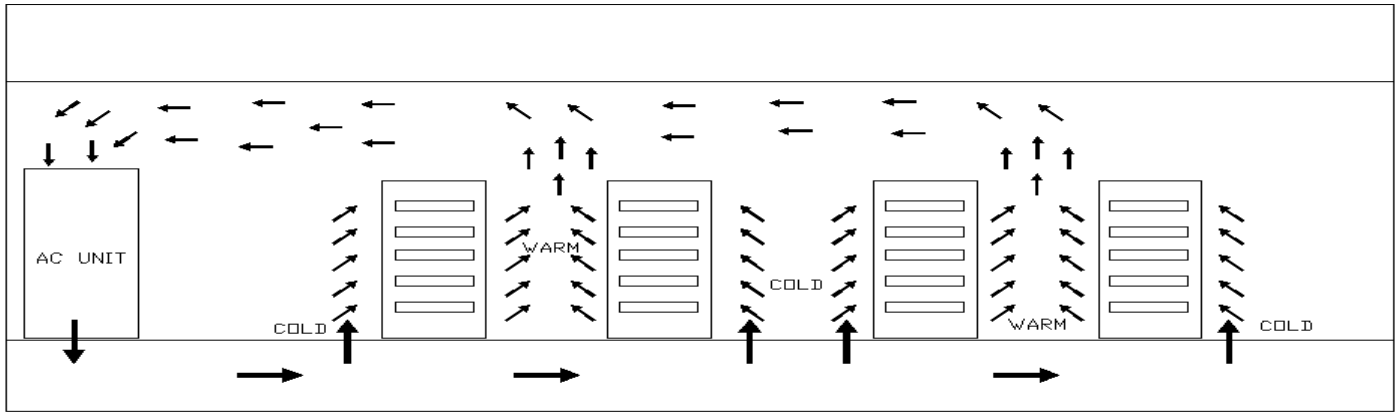
If room air is 65°F then delta T = 10°F
If room is 75°F then delta T is 20°F
Half the cfm means energy savings

How to achieve low flow and high delta T

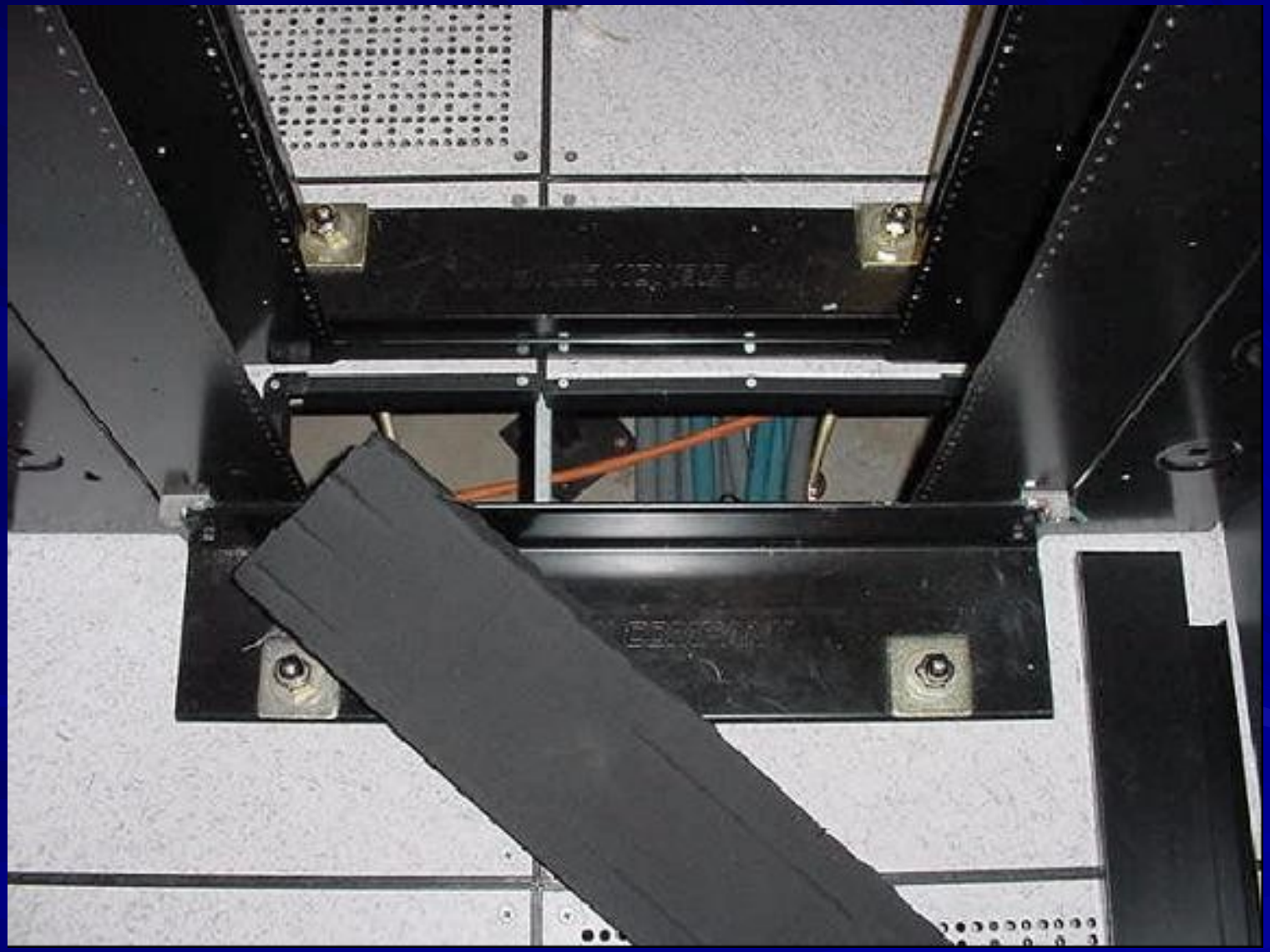
- Provide cool air where it is needed, at front of computers (air intake)
- Try to get hot air to air handling unit without blending it again with cool air.
- Create cold and hot alleys
- Seal all leaks and by-passes
- Set controls to provide coolest temp to floor space

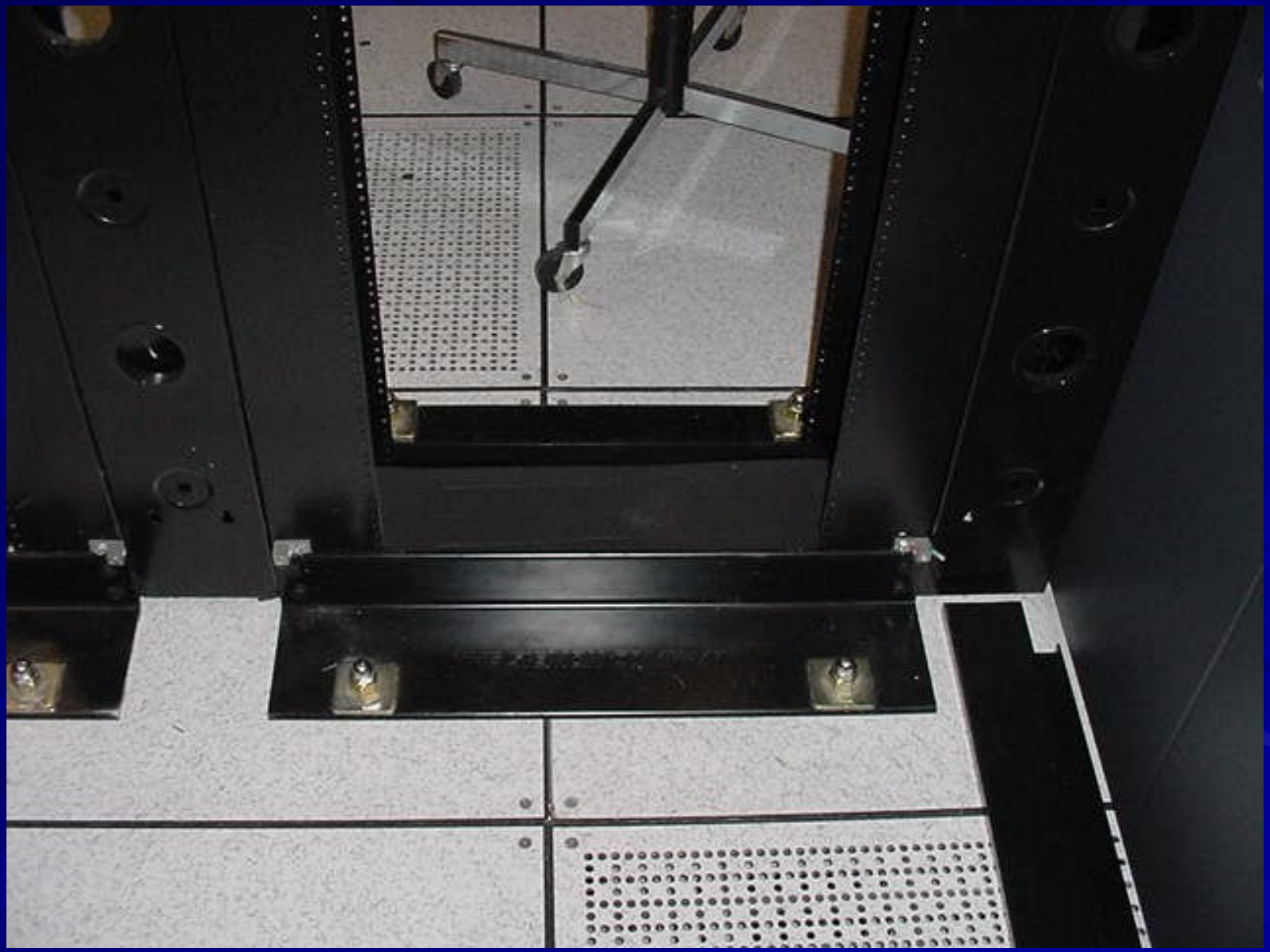


UTILIZING CEILING PLENUM



HOT AND COLD ALLEYS





Data Center Results

- Half the air handler units can be turned off
- No heating and cooling going on
- Fan power saved
- More comfortable for personnel
- Avoids cycling of compressors for DX units, longevity of equipment

Data Center Recommendations

- Team work and coordination required by:
  - Manufacturer of computers
  - Room layout architecture
  - Air conditioning engineer
- Educate personnel to be aware of principles

Energy Conservation = Happiness

Energy Conservation is,
(like Happiness),
not a Destination
but a Way of Traveling